authors were desirous of examining whether iodine would give a spectrum of the first order the reverse of the absorption-spectrum at ordinary temperatures. The vapour of iodine in an oxyhydrogen jet gave, indeed, a spectrum of the first order, but it did not agree with what theory might have led us to expect.

In the electric discharge, arsenic and mercury gave only spectra of the second order. The metals of the alkalies sodium, potassium, lithium, thallium show, even at the lower temperature of Bunsen's lamp, spectra of the second order.

Barium, strontium, calcium in the flame of Bunsen's lamp show bands like spectra of the first order, and in each case a well-defined line-like spectra of the second order. On introducing chloride of barium into an oxyhydrogen jet, the shading of the bands was resolved into fine dark lines, proving that the band-spectrum of barium is in every respect a spectrum of the first order.

Spectra of the first order were observed in the case of only a few of the heavy metals, among which may be particularly mentioned lead, which, when its chloride, bromide, iodide, or oxide was introduced into an oxyhydrogen jet, gave a spectrum with bands which had a channeled appearance in consequence of a shading by fine dark lines.

Chloride, bromide, and iodide of copper gave in a Bunsen's lamp, or the oxyhydrogen jet, spectra with bands, and besides a few bright lines. The bands in the three cases were not quite the same, but differed from one another by additional bands. Manganese showed a curious spectrum of the first order. When an induction discharge passed between electrodes of copper or of manganese, pure spectra of these metals, of the second order, were obtained.

March 10, 1864.

Major-General SABINE, President, in the Chair.

The following communication was read:—

"On the Influence of Physical and Chemical Agents upon Blood; with special reference to the mutual action of the Blood and the Respiratory Gases." By GEORGE HARLEY, M.D., Professor of Medical Jurisprudence in University College, London. Communicated by Dr. SHARPEY, Sec. R.S. Received March 3, 1864.

(Abstract.)

This communication is divided into two parts. The first is devoted to the investigation of the influence of certain physical agencies, viz. simple diffusion, motion, and temperature, and of the conditions of time and the age of the blood itself. The second part includes the consideration of

the influence of chemical agents, especially such as are usually regarded as powerful poisons.

The paper commences with a description of the apparatus employed, and the method followed in conducting the inquiry; and the details of the several experiments are then given. The following is a brief statement of the results.

Part I.

1. The experiments on diffusion showed that venous blood not only yields a much greater amount of carbonic acid than arterial blood, but also absorbs and combines with a larger proportion of oxygen.

2. Motion of the blood was found to increase the chemical changes arising from the mutual action of the blood and the respiratory gases.

3. The results of the experiment on the influence of time led to the conclusion that the blood and air reciprocally act on each other in the same way out of the body as they do within it, and that their action is not instantaneous, but gradual.

4. It was ascertained that a certain degree of heat was absolutely essential to the chemical transformations and decompositions upon which the interchange of the respiratory gases depends. The higher the temperature up to that of 38° C. (the animal heat), the more rapid and more effectual were the respiratory changes; whereas a temperature of 0° C. was found totally to arrest them.

5. The influence of age on the blood was found to be very marked, especially on its relation to oxygen. The older and the more putrid the blood becomes, the greater is the amount of oxygen that disappears from the air; and although at the same time the exhalation of carbonic acid progressively increases with the age of the blood, yet its proportion is exceedingly small when compared with the large amount of oxygen absorbed.

6. The average amount of urea in fresh sheep's blood was ascertained to be 0·559 per cent., and its disappearance from the blood during the putrefactive process was very gradual, there being as much as 0·387 per cent. in blood after it was 304 hours old.

Part II.

The chemical agents employed were animal and vegetable products and mineral substances.

1. The effect of snake-poison was found to be an acceleration of the transformations and decompositions occurring in blood, upon which the absorption of oxygen and the exhalation of carbonic acid depend.

2. The presence of an abnormal amount of uric acid in blood was also found to hasten the chemical changes upon which the absorption of oxygen and exhalation of carbonic acid depend.

3. Animal sugar, contrary to what had been anticipated, retarded the respiratory changes produced in atmospheric air by blood.

4. The influence of hydrocyanic acid was studied both upon ox-blood and human blood, and found to be the same in each case, namely, to arrest respiratory changes.

5. Nicotine was also found to diminish the power of the blood either to take up oxygen or give off carbonic acid gas and thereby become fitted for the purposes of nutrition.

6. The effect of woorara poison, both on the blood in the body and out of it, was ascertained to be in some respects similar to that of snake-poison, namely, to increase the chemical decompositions and transformations upon which the exhalation of carbonic acid depends; but differed in retarding, instead of hastening, the oxidation of the constituents of the blood.

7. Antiar poison and aconite were found to act alike, inasmuch as both of them hastened oxidation and retarded the changes upon which the exhalation of carbonic acid depends; in both respects offering a striking contrast to woorara poison, which, as has just been said, diminishes oxidation and increases the exhalation of carbonic acid.

8. The effect of strychnine on the blood, both in and out of the body, was studied, and found to be in both cases identical, namely, like some of the other substances previously mentioned, to arrest respiratory changes. Moreover, in one experiment in which the air expired from the lungs of an animal dying from the effects of the poison was examined, it was ascertained that the arrest in the interchange of the gases took place before the animal was dead.

9. Brucine acts in a similar manner as strychnine, but in a much less marked degree.

10. Quinine also possesses the power of retarding oxidation of the blood, as well as the elimination of carbonic acid gas.

11. Morphine has a more powerful effect in diminishing the exhalation of carbonic acid gas, as well as the chemical changes upon which the absorption of oxygen by blood depends.

Under this head the effects of anæsthetics upon blood are next detailed; and in the first place, the visible effects of chloroform upon blood are thus described:—If 5 or more per cent. of chloroform be added to blood, and the mixture be agitated with air, it rapidly assumes a brilliant scarlet hue, which is much brighter than the normal arterial tint, and is, besides, much more permanent. When the mixture is left in repose, it gradually solidifies into a red-paint-like mass, which when examined under the microscope is frequently found to contain numerous prismatic crystals of an organic nature. If the blood of an animal poisoned from the inhalation of chloroform be employed in this experiment, the paint-like mass will be found to be composed in greater part of the crystals just spoken of; the crystals in this case being both larger and finer than when healthy blood is employed. Chloroform only partially destroys the blood-corpuscles. Its chemical action is to diminish the power of the constituents of the blood to unite with oxygen and give off carbonic acid.

The action of sulphuric ether upon blood differs in many respects from that of chloroform. In the first place, ether has a powerful effect in destroying the blood-corpuscles, dissolving the cell-walls and setting the contents free. In the second place, ether prevents the blood from assuming an arterial tint when agitated with air. The higher the percentage of the agent, the more marked the effect. In the third place, ether neither diminishes the absorption of oxygen nor the exhalation of carbonic acid by blood; and lastly, it has a much more powerful effect in causing the constituents of the blood to crystallize. For example, if an equal part of ether be added to the blood of a dog poisoned by the inhalation of chloroform, as the ether evaporates groups of large needle-shaped crystals are formed. Under the microscope the crystals are found to be of a red colour and prismatic shape.

Alcohol acts upon blood somewhat like chloroform; it arrests the chemical changes, but in a less marked degree.

Amylene was found to act like ether upon blood, in so far as it did not diminish the absorption of oxygen or retard the elimination of carbonic acid. It differed, however, from ether in not destroying the blood-corpuscles.

In the last place, the action of mineral substances is stated, viz.:—

1. Corrosive sublimate was found to increase the chemical changes which develope carbonic acid, and to have scarcely any effect on those depending upon oxidation; its influence, if any, is rather to diminish them than otherwise.

2. Arsenic seems to retard both the oxidation of the constituents of the blood and the exhalation of carbonic acid.

3. Tartrate of antimony increases the exhalation of carbonic acid gas, while it at the same time diminishes the absorption of oxygen.

4. Sulphate of zinc and sulphate of copper both act like tartrate of antimony, but not nearly so powerfully.

Lastly, phosphoric acid was found to have the effect of increasing the chemical transformations and decompositions upon which the exhalation of carbonic acid depends.

March 17, 1864.

Major-General SABINE, President, in the Chair.

The following communications were read:—

I. "Researches on Radiant Heat.—Fifth Memoir. Contributions to Molecular Physics." By J. Tyndall, F.R.S., &c. Received March 17, 1864.

(Abstract.)

Considered broadly, two substances, or two forms of substance, occupy universe—the ordinary and tangible matter of that universe, and the